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Technical Report No. 126

# TESTING THE DEVELOPMENT OF READING AND LINGUISTIC AWARENESS

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Abstract

The development of reading and language awareness was investigated by measuring beginning letter and word knowledge in average ability five and six year old children. A letter and word reading test was constructed on the basis of a hierarchical representation of linguistic awareness of preschool children; 50 children's performance on this test was then measured at the end of kindergarten and at the beginning of first grade. A standardized measure of reading achievement at the end of first grade served to evaluate the usefulness of the test. The results indicated that the Letter and Word Reading Test is reliable and highly predictive of beginning reading achievement. Performance on the test is shown to follow the development of linguistic awareness and documented change in beginning reading competence. The results are interpreted to indicate how test performance, the children's level of reading, and linguistic awareness can be related to reading development and instruction.

# Testing the Development of Reading and Linguistic Awareness

## Overview

There is a lack of agreement concerning the specific skills of reading readiness. This is illustrated by the subtests described in the reading readiness section of the most recent Mental Measurements Yearbook (Buros, 1972). Subtests often contain several of the following kinds of measures: listening comprehension, auditory discrimination, visual discrimination, following directions, letter recognition, auditory blending, copying, word meaning, draw-a-man, learning rate, and number knowledge. Of these, visual or auditory discrimination and letter recognition are most frequently included. Lack of rigor is also evident: many of the 25 tests listed do not contain measures of content and predictive validity. Of those which have validity measures, the Murphy-Durrell Reading Readiness Test (1949) and the Metropolitan Readiness Tests (1976) are among the best: predictive validity is about .60, which means that 36% of the variance in later reading achievement can be accounted for by these measures. However, the low predictive validity of even these two tests and persistent comments in the education literature that teacher judgment is depended upon more than the most widely used tests (e.g., Cochrane, 1976) suggest that reading readiness measures are not meeting expectations of users.

Recently developed reading readiness tests indicate a change in focus from overall reading readiness measures (such as those mentioned above) to linguistic and beginning reading skill measures. In the New Canadian Reading Readiness Test (Ollila, 1972; Evanechko, Ollila, & Downing, 1973),

there are 13 subtests; 6 are concerned with the child's conceptualizations about the nature and purpose of written language. In the new Prereading Phonics Inventory (Durrell & Murphy, 1978) one language measure (sentence segmentation) is included. The other subtests describe beginning reading skills or knowledge (letter names, writing letters, and discrimination of letter sounds). This apparent shift to measures that are more directly related to reading or to a linguistic awareness about print is encouraging because it may not only lead to improvements in evaluating beginning reading abilities, but also to a better understanding of the relationship between language development and reading development.

Given that many assessments of reading readiness include widely dispersed test items and are limited in predictive validity, what is known about the relationship between predictors and reading achievement? A comprehensive review by Livo (1972) cites the following four areas as predictors of success in beginning reading: auditory discrimination factors, visual discrimination factors, oral language development, and intelligence. However, the fact that these dimensions are defined, labeled, and measured in varying ways across studies and reading readiness tests diminishes the interpretive value of this analysis. Of the more specific measures, letter naming has been shown the single most efficient predictor of reading achievement (Dykstra, 1967; Lowell, 1970), continuing as a predictor through the elementary years (Muehl & DiNello, 1976). In many instances the letter naming subtest is as efficient in predicting reading achievement as the entire readiness test. Yet, letter naming must be a correlate rather than

a causal factor since specific instruction in letter naming has not resulted in helping children learn to read (Silberberg, Silberberg, & Iverson, 1972; Samuels, 1972).

Bilka (1971) found that the strongest predictors of reading achievement in grades one to three are a combination of the phoneme and letter name knowledge subtests from the Murphy-Durrell Reading Readiness Analysis and the word meaning and alphabet knowledge subtests from the Metropolitan Readiness Test. This finding was upheld for students taught by a basal approach or taught by a language experience approach. Thus, letter sound knowledge should perhaps be added to letter name knowledge in measuring beginning reading.

In the New Canadian Reading Readiness Test (Ollila, 1972; Evanechko, Ollila, & Downing, 1973), four factors were found within the 13 subtests which accounted for 64% of the variance in first grade reading achievement. In order of importance the four factors are: general reading readiness (accounting for 28% of the variance in reading achievement), listening (accounting for 15%), conceptualizing about the nature and purpose of reading (accounting for 10%), and literacy behavior (accounting for 9%). Although this test is a remarkably good predictor (accounting for 64% of the variance), it would be more useful to teachers and researchers if it could be shortened and the general factor interpreted.

## Problems with Current Reading Readiness Testing

The need for further clarification of the skills involved in reading readiness is clearly noted by the fact that the variance in reading

achievement predictable from the older readiness tests has been only about 36%. While the New Canadian Reading Readiness Test is a better predictor of reading achievement, the general reading readiness factor which accounts for about half of the predictable variance lacks the specificity which would be helpful in understanding the nature of reading readiness and thus in drawing diagnostic implications from varying test performance.

Underlying the problem of specificity, however, is a more critical difficulty: There is no agreed upon theoretical base for explaining how particular factors are related to learning to read. At least three different theoretical explanations are apparent: (a) reading is closely related to general intelligence, which is then measured by a wide assortment of tasks; (b) reading can be interpreted and measured by vocabulary, decoding, and comprehension tasks; or (c) reading progress is determined by the development of lingustic awareness about print and by knowledge of such constructs as letter-sound pattern regularity and morphophonemic principles.

## Focus of this Study

A prereading and beginning reading test was devised and evaluated in order to determine whether or not the third explanation, the development of linguistic awareness, could predict reading competency differences. The test, which drew upon earlier observations and testing of four year old children (Mason, 1977a), was constructed to relate prereading and reading skills to levels of linguistic awareness. In this paper, it is evaluated for predictive validity through a comparison with the

Gates-MacGinitie Reading Achievement Test (1965); stability, scalability, reliability, and a developmental underpinning are determined by testing children at the end of kindergarten and again at the beginning of first grade. If it can be demonstrated that the test is not only structurally sound but contains a developmentally sound scale, both subtest scores and error analyses should be appropriate for measuring children's reading competencies. It is hypothesized, then, that a developmental hierarchy of linguistic awareness is a valid construct for measuring reading competency. Further, by postulating a hierarchy, the distinction between readiness and beginning reading falls away: "Readiness" to read is the acquisition of linguistic concepts about printed letters and words.

Relationship of Linguistic Awareness to Test Construction

A hierarchical representation of linguistic awareness is assumed to characterize beginning reading. The first level is thought to be letter discrimination ability. Letter knowledge is a significant predictor of reading and, in a study of four year olds (Mason, 1977a), was found to precede letter-sound discrimination ability and recognition of most words. Naming letters, printing letters, and reciting the alphabet were found to accompany children's learning of letters and rules for letter recognition--such as that the same letters can be of different sizes, colors, or type fonts but cannot be turned upside down. Note that letter naming, in and of itself, is not the critical piece of knowledge; it is awareness of how letters are discriminated. Letter naming is, however, a straightforward means of assessing letter discrimination ability. For that reason,

this test contains a letter naming task using some of the more frequently used upper and lower case letters.

The next level of development is hypothesized to be related to consonant-sound knowledge. This is one step beyond letter identification because it requires a realization by the child that letters are also represented by particular letter sounds and that those sounds can be identified in words. At this level, children are learning to match some consonants with phonemes in words. Three kinds of tasks, spelling, word-picture matching, and consonant-sound identification, have been used to measure this knowledge. The reason that all of these are relevant can be seen from a task analysis. In a spelling task the child must pull apart the sounds in a word, matching them to letters. In a picture-word task, using pictures of common objects and a choice of words, the child needs to attend to phonemes heard in a spoken word to identify the correct matching printed word. In a consonant-sound identification task, using three-letter nonsense words and a single, unscored vowel (e.g., bak, kam, mab), the child must encode consonants as sounds and then put together the sounds to create a single unit. In these three tasks, the words are restricted in letter length. Otherwise the child could be overwhelmed by the number of phonemes that must be distinguished, remembered, and matched. Words rather than letters are the basic units in these tasks because what is being measured is an ability to relate letter sounds to phonemes in words, not merely an ability to say the letter sounds. Nonwords are preferred to real words in the consonant-sound identification task because the task is then simplified by using the same vowel for all items.

Word reading and vowel-sound identification are hypothesized to be at the third level of development. At this level, the child must correctly produce the vowel sound in addition to the consonant sounds, attending to all the letter sounds. The word reading task utilizes two- and three-letter common words; the vowel task requires the child to correctly identify the sound of one or two vowels in three- or four-letter nonsense words. Both tasks are more difficult than the consonant task for the following reasons: (a) vowel sounds lack the more obvious regularity of the consonant sounds and are phonetically more difficult to distinguish than consonants; and (b) selection of a correct vowel sound requires the reader to analyze the surrounding letters. Thus, reading real or nonsense words out of context are at the third level because they test children's realization of letter cluster-to-sound pattern regularity.

Three levels of linguistic awareness are hypothesized to account for the beginning development of reading competency: letter discrimination, representation of phonemes in words with sounds of consonants, and multiple classification of letter sounds within words. They are thought to describe the early development of reading; furthermore, test items and tasks are believed to be appropriate for prereaders and beginning readers because the test spans reading readiness and beginning reading attainments.

## Method of Test Evaluation

Subjects. Subjects were three classrooms of kindergarten students ($N$ = 66) from an elementary school in a low-middle income area of a large city. They were tested individually by an experimenter in April

(8th month) of their first year of school (kindergarten) where a language experience approach to reading had been used by all teachers. Fifty-nine of the children were retested in September. Fifty children from this group were also given a school-administered Gates-MacGinitie Test at the end of first grade. On the first two occasions subjects were individually tested over a three-day period. The Gates-MacGinitie Test was given in groups.

Materials. A Letter and Word Reading Test (LWRT) was constructed in accordance with the developmental hierarchy described above. The test is comprised of six word and letter identification tasks given in this order: picture-word matching, spelling, letter naming, common word reading, consonant-sound, and vowel-sound identification.

In the picture-word subtest, subjects were shown eight 10 x 12 inch cards, each with a picture of a familiar object (cat, dog, mom, book, exit, stop, milk, man). Handprinted in upper case letters around the picture was the correct printed word and three incorrect words (see Figure 1). One incorrect word contained only a vowel change, another contained the correct initial letter, and the third had no correct letters. The child named the picture, was corrected if necessary, and then was asked to point to the correct printed word.

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Insert Figure 1 about here

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Two scoring systems were devised and compared. In one, three points were given for the correct match, two for the vowel-only change, one for

the initial letter match, and zero for the completely incorrect choice. In the second scoring system, the correct response was scored as 1 and any other was zero. The second system was chosen for this analysis because the other did not improve correlational results, although for diagnosis, the first system may give useful information. With either scoring, the test provides an indication of the extent to which the children have begun to attend to printed words in their environment and can match phonemes heard in words to printed letters.

The spelling task examines children's ability to segment words into their phonemic representation and relate that to individual letters. Children were provided with upper case magnetic letters--TPCAOSK--and a metal board. They were asked to spell these words: CAT, TOP, AT, and POT. One point was given for each letter in its correct location. For example, three points indicated correct spelling of the three-letter words; two points were assigned for two correct letters, e.g., PAT, TOT, or PO for POT; and one point for one letter in position.

The letter name knowledge task indirectly measures letter discrimination ability by assessing letter name knowledge. The examiner placed ten upper case letters in a predetermined, mixed order on a metal board. These were followed by the same ten lower case letters in a different mixed order. The letters were RPHFADTMEB. Each score was the total number of letters correctly named.

Common word reading measures the decoding of isolated words, determining whether or not the child has begun to realize the complexity of

vowel and consonant sounds within words. Twenty-eight words were hand-printed in lower case on 3 x 5 cards. These words were selected from the Dolch (1936) 220-Word list in order to insure their recognizability to the child. The 28 words were differentiated in terms of vowel sound complexity (one or two vowels), word length (two or three letters long), and vowel regularity as defined by Venezky (1970) or Mason (1977b). (The words and, use, may, at, and had are regular; all, one, saw, or, and put are irregular.) Children were asked to read as many of the words as possible, being assured that there would be many that they would not know. Three scores were created, one for the total number of words read correctly, and one each for the number of regular and irregular words read.

The consonant-sound identification task utilizes nonsense words to test an ability to ascribe correct consonant sounds to letters and say both in the correct left-to-right order. Subjects were shown 16 hand-printed 3 x 5 cards containing consonant-vowel-consonant (CVC) pronounceable non-words, and asked to read them. The vowel a, which was used throughout to make the task easier, was ignored in the scoring. The first eight non-words contained consonants whose sound coincides with the initial part of the letter name (strings such as bak, pav, tab, and daz). The remaining eight were words containing consonants whose sound is not described by the initial part of the letter name (strings such as fac, lam, ras, and waf). Thus, in addition to obtaining a summary score of the number of correctly pronounced consonants in each non-word, the results of the two sets of words could be compared in order to determine if children are using the letter name as a cue to learning the consonant sound.

In the vowel-sound identification task, the child was asked to read aloud 20 pronounceable non-words which were hand-printed in lower case letters on 3 x 5 cards. There were five words each for four vowel patterns: the first was a short vowel sound (CVC) pattern, the second and third a long vowel sound (CVCe, CVVC, and CVV), and the fourth consisting of r-influenced vowels (CVre). Here is one example from each type: bek, nabe, vay, kore. Credit was given for each correctly pronounced vowel; the consonant sounds were ignored. In this task, all the major types of one syllable vowel-consonant patterns were tested in order to determine whether there is an order of difficulty among these patterns and more generally, to assess children's understanding that there are many regular vowel cluster-to-sound patterns.

Descriptive Results

Contrary to popular folk wisdom, these children did not lose what they had learned in school because of a summer vacation. The test-retest results showed a score increase on every part of the test; further, nearly every child made a gain on more than one subtest. The average number of subtests on which children gained was 3.96. There were, however, large differences in subtest score changes. The three easiest tasks had a small score increase over the summer: upper case letter naming (93% correct in the spring and 97% on the fall retest), lower case letter naming (87 to 96%), and spelling (81 to 88%). Three which were of moderate difficulty showed the greatest score gain over the summer: consonant-sound identification (59 to 74%, a gain of 15%), picture-word matching (69 to 84%, a gain

of 15%), and word reading (26 to 42%, a gain of 16%). Vowel-sound identification changed very little: CVCe, CVV or CVVC, and CVre pattern scores ranged from 5 to 20% correct in the spring and 12 to 23% after the summer vacation; the CVC short vowel pattern score improved from 40 to 48%. Overall, the scores of the easiest and most difficult tasks increased about 5% during the summer, while those of moderate difficulty increased about 15%. Means and standard deviations are shown in Table 1.

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Insert Table 1 about here

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Standard deviations increased on two of the subtest scores, common word reading and vowel-sound identification. The common word reading subtest had a greater dispersion on the second testing because of improvements made by some children. Thirty-two percent of the children made a 21 to 68% improvement over the summer; 47% made between a 1 and 26% improvement, and 21% made no change or reduced their score by 1-4 points. Three-quarters of this 21% had obtained a score of 0-14% in the spring, which suggests that children who know the least at the end of the school year are also the least likely to learn more during the summer. While their loss was small, many other children made substantial gains. On the vowel-sound subtest, the greater variability over time was the result of a few children improving while most remained at or near zero.

## Test Evaluation Results

Stability. An evaluation of stability was determined here by subtest and whole test intercorrelations from Time 1 (May) to Time 2 (September).

For the total test, the test-retest correlation was .85. Most subtest score correlations were somewhat lower: picture-word matching, .55; spelling, .67; letter naming, .89; word reading, .80; consonant identification, .75; and vowel identification, .57. Component-subtest scores, which are listed in Table 2, varied from .43 to .90. Worth noting is that regular vowel words, matched consonants, and short vowels had test-retest correlations that approximated the respective subtest values.

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Insert Table 2 about here

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As would be expected in measuring stability of subtest scores, the stability coefficients for subtests varied considerably and were lower than that for the whole test. Letter naming was probably stable because most of the children were unerringly accurate at both time periods. Word reading and consonant identification seemed to be stable because of fairly consistent improvement by most children. Vowel identification had lower test-retest correlations, not because of an inherent instability, but because of erratic small gains or losses, perhaps due to lucky guesses on one or two items. These differences in subtest stability values are interpreted to indicate an adequate range of difficulty of the test, while the high overall test stability value (.85) suggests a content that is well placed at measuring kindergarteners' and first graders' abilities.

Internal consistency. Test consistency was determined from the Kuder-Richardson Formula 21, which requires information about the total number of items, test means, and standard deviations. While the reliability of the

test as a whole was very high at both time periods (.95), only one subtest and one component of a subtest maintained strikingly low values (see Table 2). These two, which had values under .50, also contained the fewest number of items. Picture-word matching had eight items and short vowel identification had only four items. It is apparent that these two tasks should contain more items if separate analyses are desired.

Predictive validity. This was examined first with correlations between subtest scores from both time periods, and the Gates-MacGinitie was given at the end of the first grade (nine months and a year after Time 1 and Time 2 test sessions). All correlations were significant at or beyond the .01 level, indicating that every subtest measured skill or knowledge which was directly related to achievement in beginning reading (see Tables 3 and 4). The range of subtest correlations with vocabulary achievement at Time 1 was .40 to .69, with the vowel subtest showing the lowest correlation. The subtest correlations with comprehension achievement at Time 1 ranged from .36 to .59, with the vowel test scores again showing the lowest correlation. Correlations between achievement scores and the vowel subtest were low because nearly all children performed uniformly poorly at Time 1 in vowel identification. The testing at Time 2 showed mostly higher correlations between subtests and achievement scores. For vocabulary the correlation range was .38 to .81, with letter naming now giving the lowest correlations; for comprehension the correlation range was .35 to .81, with upper case letter naming subtest again having the lowest correlation with comprehension.

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Insert Tables 3 and 4 about here

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The vowel subtest was correlated more highly with achievement scores on the second testing than the first since the children with more advanced reading skills improved their performance on vowels after the summer months. The letter naming subtest correlated less well with achievement on the second testing because most children then obtained nearly perfect scores.

Next, several stepwise regression analyses were run to tease out the degree and type of relationship between reading achievement and subtest scores as well as an overall score. Regression analyses were run with Time 1 and Time 2 variables separately and then together; also with summary scores from the test, subtest scores, and components from the subtests. Further, because the Gates-MacGinitie is composed of 2 tests, vocabulary and comprehension, analyses were run on a combined achievement score and on vocabulary and comprehension separately. To summarize first, Time 2 predictions of achievement were better than Time 1 predictions, subtest scores from the Letter and Word Reading Test were better than a summary score of the Test, some components were as effective as subtests, and the Test was somewhat better at predicting vocabulary and the combined achievement score than comprehension.

Using the Test summary score (sum of all subtest scores) to predict reading achievement resulted in a correlation with vocabulary at Time 1 of .74 and at Time 2 of .83; the Test was correlated .61 with comprehension at

Time 1 and .79 at Time 2. Thus, between 37 and 69% of the achievement test score variance was predictable from the Time 1 or Time 2 summary score information; the highest predictions were found from Time 2 scores.

The six subtest scores for Time 1 and Time 2 were next used as predictors of reading achievement. The multiple correlation was higher than with the summary score of the test. Prediction of the combined achievement score was the highest (multiple $r$ = .87), followed closely by prediction of vocabulary (multiple $r$ = .86), then, of comprehension (multiple $r$ = .83). In all three analyses, the Time 2 word reading subtest was the first entered predictor, accounting for most of the variance and followed by Time 2 consonant-sound identification. Adding slightly (significant at .10 level) to predictions of vocabulary was the Time 1 picture-word match subtest, and adding slightly to predictions of comprehension was the Time 1 consonant-sound identification subtest. It is apparent that Time 2 test scores provide much more accurate assessment data than do Time 1 scores. Regression values are listed in Table 5.

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Insert Table 5 about here

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A further breakdown of variables was then carried out in order to compare the predictive power of particular components of four of the subtests. Letter naming was separated into upper and lower case, word reading into regular and irregular vowel words, vowel-sound identification into short and nonshort vowels, and consonant-sound identification into consonants matched--where the sound of consonant coincides with the initial part of the

consonant name--and consonants not matched. Time 1 variables were then run in separate regressions from Time 2 variables. The Time 2 analyses, which are displayed in Table 6, indicated that two subtest components at Time 2 were nearly as effective at predicting vocabulary as three subtest scores in the previously described regressions had been. Regular vowel word reading, accounting for 63% of the variance, and consonants matched, which added 10%, together accounted for 73% of the variance (multiple $r$ = .86). The best prediction of comprehension using Time 2 variables was regular vowel word reading, accounting for 62% of the variance, total consonants which added 6%, and spelling (2%). The multiple $r$ was .83. Thus, there was no loss in predictability of either vocabulary or comprehension when word reading was restricted to the components of the subtest scores. Reading regular vowel words and identifying consonants that are matched with the initial sound in the name were as effective in predicting reading achievement as the more complete subtest scores. While suggesting that these two components are the principal factors, the effects should be explored further by varying test materials.

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Insert Table 6 about here

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Time 1 analyses did not provide so clear a picture. Since the children were younger at Time 1, somewhat different predictors emerged (see Table 7). For vocabulary, consonants not matched was the best predictor, accounting for 48% of the variance, followed by picture-word matching with 7% of the variance, and lower case letter naming and regular vowel reading which together accounted

for 6%. The multiple correlation was .78. With comprehension, regular vowel word reading accounted for 34% of the variance, and upper case letter naming provided an additional 8%; the multiple r was .65.

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Insert Table 7 about here

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The shift in predictability from Time 1 to Time 2 may be partially due to changes in the score ranges. At Time 1, the two most difficult subtests, word reading and vowel identification, had a substantial number of very low scores and a narrow range of scores while at Time 2 there was a much wider range. Letter naming was affected by a ceiling effect at Time 2. Thus, letter naming had higher Time 1 correlations while word reading and vowel identification had higher Time 2 correlations. These changes in correlations affected predictability of reading achievement.

Scalability. Scatterplots were obtained between the Time 1 and Time 2 periods for subtest scores and components of subtest scores to test the validity of the hierarchical model. Four distinctions were devised in order to describe differences among the scatterplots: linear--points form a straight line or ovoid in a diagonal direction across the graph; regular scalar--points are clustered in a triangular shape above or below the diagonal; irregular scalar--a few points are outside the triangular area; and reduced scalar--most points are along two outside margins of a triangle. Examples of each are shown in Figure 2.

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Insert Figure 2 about here

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Linear scatter plots were found between upper and lower case letters, regular and irregular words, matched and unmatched consonants, spelling and picture-word matching, and word reading and short vowel identification. There was a reduced scalar plot between letter naming and every other task; thus, letter naming was clearly at the bottom level of the hierarchy. Both spelling and picture-word matching formed irregular scalar plots against consonant identification but regular scalars against word reading and vowel identification. This places spelling and picture-word matching barely below consonant identification but clearly below word and vowel reading tasks. Consonant identification formed a regular scalar against word reading and vowel identification. Thus consonant identification is also below these tasks. Next, word reading formed an irregular scalar against short vowel identification but a regular scalar against nonshort vowel identification. These results determine that the subtests are ordered: letter naming < spelling = picture-word match < consonant identification < word reading = short vowel identification < nonshort vowel identification.

This ordering was confirmed in an analysis of children's scores after grouping them by reading ability. The 50 children's Gates-MacGinitie scores were first plotted in order to identify two natural cutoffs. Six children who had the lowest scores were grouped together; 22 each were placed in middle and high achievement groups. Next, average subtest scores were computed for each group. The listing in Table 8 shows in several ways the scalar properties of the Letter and Word Test. First, for each group and

at each testing period, subtests were ordered nearly as found from scatterplots and predicted in the hierarchical model. Secondly, the lowest group made improvements between the two testing periods on the easiest subtests (upper and lower case naming and spelling), the middle group made the most progress on tasks at the middle range (picture-word matching and consonant identification), while the highest group made the greatest progress on a higher leveled task, word reading. Further, if an average of 90-100% can be assumed to indicate task proficiency and each subtest to measure a different proficiency, it is also true that the lowest group was not yet proficient at any of the tasks; the middle group was proficient at letter naming and, by fall, spelling; and the highest group was proficient at letter naming, spelling, was nearly proficient at picture-word matching, and just barely so at consonant identification. All of these analyses follow relatively closely both the ordering determined by the scalar analysis and that predicted from the developmental hierarchy.

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Insert Table 8 about here

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## Discussion

Descriptive. An increase on reading readiness test performance after the summer recess has not been previously documented. The only reading readiness test in Buros (1972) which provides norms for end of kindergarten and beginning of first grade performance was the Gates-MacGinitie Test which indicated very little change in the scores at these two testings. In contrast,

48 of the 50 children studied here increased their scores on one or more subtests after the summer recess, the increasing subtest scores following a predictable pattern as indicated in Table 8. The group with the lowest achievement at the end of the first grade (and the lowest overall LWRT scores) increased primarily on the easiest subtests (letter-naming and spelling), the middle group showed the largest increase on consonants, and the upper group showed their greatest improvement on the word reading subtest. This upper group was also the only one with increased scores on the nonshort vowels.

Gains by each group indicate that most of the children are acquiring knowledge about words and letters without the aid of teacher instruction, although it is likely that the children have home environments which encourage reading activities. Further, the pattern of improvement is consistent with the developmental hierarchy of linguistic awareness which was used to construct the test. Those children who perform least well improve most on the easier tasks; children who have already mastered the easier skills improve on the more advanced subtests. These results are interpreted to indicate that, if narrowly defined tests are constructed, most children will improve in the order predicted by the developmental hierarchy. This should be verified through further testing of other normal children.

Predictive power. The variance accounted for using the LWRT varied from .421 to .755, depending primarily on the time the test was given. This test accounts for more variance in first grade reading achievement than any

of the reading readiness tests cited in Buros (1972). Even the recently developed New Canadian Reading Readiness Test accounts for less variance in achievement. The predictive power of the test is thought to result from its hierarchical structure and from its close tie with actual reading accomplishment.

In all the regression analyses, the Time 2 word reading subtest and the Time 2 consonant-sound identification subtests were the best predictors. Further, two components of these subtests, regular word reading and consonants-matched were each as effective in predicting reading achievement as the entire subtest. The question of why these two tasks should be the most predictive has a straight forward answer. Letter discrimination is assumed to be at the first level of linguistic awareness. Because most of the children tested here had learned to discriminate and name letters, an adequate test was better formed around testing competency at the second and third levels of linguistic awareness. At Time 2, most of the children ranged widely in word reading and consonant identification. This knowledge, which is a necessary aspect of beginning reading, is also required for beginning reading achievement tests (the Gates-MacGinitie Test, for example, uses familiar words and short sentences). These results suggest that, if the abilities to recognize letters have been acquired, children are very effectively tested by tasks which measure recognition of consonant sounds, vowel sounds, and short words.

How is it possible that letter-naming, which is often cited as the best single predictor of beginning reading achievement, was such a poor predictor

in this study? In fact, by the beginning of first grade most of the children could correctly identify most or all of the letters presented. Three possible reasons can be given for this difference. First the impact of television programs such as Sesame Street and the accompanying interest of children in letters may account for their relatively more advanced knowledge about letters and letter sounds. (This increase in letter knowledge has been cited by Barth & Swiss, 1976.) Second, since the LWRT was constructed on the basis of a hierarchical structure, the tasks are congruent with children's developing knowledge about letters and words. Scalability and specificity make this test very responsive to ongoing change. Third, children from very low income neighborhoods, who typically do not recognize letters, were not tested. Since most of the tested children did know their letters, this range restriction limited the predictive power of letter naming.

Hierarchical ordering. Comparing the order predicted from the hypothesized hierarchy with the results of the scaling analyses confirms most facets of the hierarchy and provides evidence that there is a strong relationship between linguistic awareness and early steps in learning to read.

There were some differences between predicted and obtained ordering which need to be explained. It was thought that spelling, word-picture matching, and consonant identification would describe equally well the ability to relate consonant sounds to letters and words. Scatterplots, however, indicated that spelling and picture matching were slightly easier than consonant identification; yet scores of average change over the summer

showed that spelling was somewhat easier than the other two subtests. Since these three tasks were testing letter-sound to word-sound knowledge in somewhat different ways, minor deviations in the results are not surprising. Even though similar, all three measures may be useful because a teacher can look at all three scores and the types of errors made on each task to determine what the child understands about letter sounds and how the child tries to apply letter sounds to printed words. It seems, then, that these three tasks should be included and be placed at the same hierarchical level; however, further study of this conclusion is warranted.

The other deviant result was that word reading was expected to be equivalent to vowel identification. Scatter plots showed that word reading and short vowels were learned at the same time while nonshort vowel patterns were at the end of the hierarchy. Also, scores of change over the summer showed that short vowel identification preceded word reading which preceded nonshort vowels. These differences from the predictions suggest that the developmental hierarchy should be amended: abilities to identify short vowel sounds and read three letter common words may be learned at about the same time while vowels that utilize more complex patterns appear to be learned later. Thus, a hierarchy relating linguistic awareness to reading development may consist of at least four levels. The third level of awareness may be limited to an understanding of three-letter common words and short vowel patterns. The fourth level may be an extension of knowledge of one-syllable words to r-controlled patterns, long vowel/silent e patterns, and vowel digraph

patterns. Given children's poor performance on this subtest, it is likely that these patterns are not usually differentiated until children are instructed; however, this possibility was not studied here.

## Theoretical Implications

There is no apparent reason to construct a wide range of tasks and items to test reading readiness and beginning reading if it is knowledge about letters, their sounds, and short words that is needed. Although there may be a general factor of intelligence influencing an ability to read, that does not preclude the use of narrowly defined measures of reading competency. The theoretical construct of a hierarchical ordering of linguistic awareness which affects what children attend to and are able to learn about letters and print is a very effective basis for test construction. It appears to be more accurate than tests which rely on general readiness for reading or on vocabulary/decoding/comprehension distinctions. However, since most of these results stem from a final group of only 50 children, all of low-middle or middle income families, further testing is needed before generalizing to other populations of children.

## Instructional Implications

The content of the LWRT was shown to be highly predictive of beginning reading success. Several reasons can be given to explain its effectiveness. First, because the Test is sensitive to four levels of linguistic awareness, children's competencies in letter and word knowledge are discriminated at high and low extremes as well as in the middle range. Second, the fact

that the majority of children scored 30 to 70% correct on four of the subtests (picture-word, spelling, consonant-sound identification, and word recognition) indicates that item difficulty is appropriate for good discrimination within levels of knowledge. Third, because test development was based on longitudinal observation and testing of younger children who were learning about how to read from parents, books at school, and educational television, the knowledge measured is not dependent on specific instructional experiences (which could have produced an unexplainable and limited effect on letter and word knowledge) but on a plausable natural development of linguistic knowledge that is related to reading.

The test results, both scores and errors from the subtests, are valuable in at least two ways: (1) the level of linguistic awareness can be specified for those children with extreme scores and approximated for those children in the middle range; (2) the child's focus of attention can be inferred from the kinds of errors made. Analyses of scores and errors explain both points next.

Determination of the child's level of linguistic awareness is based on near perfect scores on subtests that measure that level. For example, the letter naming subtest which describes the first level of linguistic awareness had six children who missed more than 40% of the letters at the end of kindergarten; all of them had scores close to zero on all of the other subtests except the picture-word task. Thus, those six children were at the first level of linguistic awareness. The consonant-sound identification subtest which represents the next level in the developmental hierarchy of linguistic

awareness, was mastered by the upper 44% of the children. Identification of nonshort vowel patterns, the fourth level of awareness, was not mastered by any of the children. It seems that at any level of the hierarchy low performance (zero to about 10% correct) indicates a lack of linguistic awareness; moderate performance suggests that the knowledge is being acquired; and high performance (scores of 90 to 100% correct) presumes that the knowledge for that level has been acquired. This conclusion needs to be confirmed by testing other samples of children.

Analysis of children's errors provide information which can be used to infer their focus of attention. The letter naming subtest indicates which letters children do not know, as well as difficulty with directionality or upper case/lower case differences. For example, on the first testing the lower case b and d were the only consistent errors: 38% of the children misnamed both b and d; an additional 38% misnamed either b or d. Errors on the picture-word task reveal knowledge of words as well as consistencies in error pattern. Do children neglect the vowel, attend only to the initial letter, or attend to none of the letters? On the first testing of the picture-word test, 82% of the errors were the word with only the vowel changed; 18% of the errors were the word on which only the initial letter matched the correct word, while only one error out of the 178 was the choice of the word containing no letters in common. On the spelling subtest, it can be determined whether children match initial or final sounds of words to the letter or use the vowel to spell words. Analysis of the three-letter word spelling errors from the first test

indicated that 87% of the production errors had the initial letter correct, 51% of the errors had both the initial and final consonant correct, while 12% of the errors had the vowel correct. The word reading and consonant identification tasks can be used to identify the number of phonemes matched to printed words and nonwords, which phonemes are known, and how closely children's responses resemble the printed stimuli. Errors on the vowel subtest show whether or not children recognize the more complex predictable letter cluster patterns.

The Letter and Word Reading Test should be an important aid for student placement in reading groups in first grade. It may prove to be valuable for diagnosis as well. However, since only normal children were tested, this test may be somewhat limited in its scope and usefulness. Use as a diagnostic instrument is, as yet, untested; it appears to be a valid indicator of children's reading or learning strategy. However, these interpretations are based on analyses of trends in children's errors, not on an evaluation of remediation attempts. Thus, the recommendations of its diagnostic value must be considered speculative.

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Table 1

Means and Standard Deviations for Subtests

at Time 1 and Time 2

| Subtests | Time 1 | | Time 2 | |
|---|---|---|---|---|
| | $\bar{x}$ | s.d. | $\bar{x}$ | s.d. |
| Picture-word match | 5.50 | 1.75 | 6.18 | 1.56 |
| Spelling | 8.92 | 2.83 | 9.66 | 2.12 |
| Total letters | 18.04 | 3.53 | 18.86 | 2.46 |
| Upper case letters | 9.34 | 1.96 | 9.70 | 1.29 |
| Lower case letters | 8.70 | 1.74 | 9.16 | 1.34 |
| Word reading | 7.28 | 5.55 | 11.68 | 8.00 |
| Regular vowel words | 4.10 | 2.85 | 6.04 | 4.49 |
| Irregular vowel words | 3.18 | 2.93 | 5.64 | 3.78 |
| Consonant-sound identification | 18.76 | 10.36 | 23.52 | 8.49 |
| Consonants matched | 9.76 | 5.57 | 11.96 | 4.45 |
| Consonants not matched | 9.00 | 5.09 | 11.56 | 4.30 |
| Vowel-sound identification | 3.84 | 3.42 | 4.92 | 4.53 |
| Short vowel | 2.00 | 1.53 | 2.42 | 1.55 |
| Nonshort vowels | 1.84 | 2.48 | 2.50 | 3.72 |

Table 2

Stability and Internal Consistency for Subtests

| Subtests | Internal Consistency | | Stability (Test-Retest) |
|---|---|---|---|
| | Time 1 | Time 2 | |
| Whole test | .95 | .95 | .85 |
| Picture-word match | .44 | .42 | .55 |
| Spelling | .79 | .74 | .67 |
| Total letters | .86 | .82 | .89 |
| Upper case letters | .84 | .83 | .90 |
| Lower case letters | .63 | .57 | .74 |
| Word reading | .83 | .89 | .80 |
| Regular vowel words | .63 | .82 | .78 |
| Irregular vowel words | .72 | .78 | .74 |
| Consonant-sound identification | .93 | .91 | .75 |
| Consonants matched | .88 | .85 | .75 |
| Consonants not matched | .85 | .83 | .65 |
| Vowel-sound identification | .73 | .82 | .57 |
| Short vowels | .49 | .48 | .61 |
| Nonshort vowels | .74 | .85 | .43 |

Table 3

Correlations Between Achievement Scores[a] and Subtest Scores

| Subtests | Testing 1 | | | Testing 2 | | |
|---|---|---|---|---|---|---|
| | Vocab-ulary | Compre-hension | Com-bined | Vocab-ulary | Compre-hension | Com-bined |
| Whole test | .74 | .61 | | .83 | .79 | |
| Picture-word match | .60 | .50 | .57 | .68 | .54 | .63 |
| Spelling | .67 | .50 | .60 | .55 | .37 | .47 |
| Total letters | .59 | .50 | .56 | .46 | .43 | .47 |
| Upper case letters | .54 | .48 | | .38 | .35 | |
| Lower case letters | .59 | .46 | | .47 | .46 | |
| Word reading | .64 | .57 | .62 | .81 | .80 | .83 |
| Regular vowel words | .64 | .59 | | .79 | .79 | |
| Irregular vowel words | .58 | .50 | | .78 | .76 | |
| Consonant-sound identification | .65 | .51 | .59 | .77 | .72 | .77 |
| Consonants matched | .58 | .45 | | .78 | .70 | |
| Consonants not matched | .69 | .54 | | .70 | .69 | |
| Vowel-sound identification | .51 | .45 | .50 | .60 | .65 | .67 |
| Short vowels | .48 | .43 | | .54 | .50 | |
| Nonshort vowels | .40 | .36 | | .51 | .58 | |

[a]Gates-MacGinitie Primary Form

Table 4

Subtest Intercorrelation Matrix[1]

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1. | Letter naming | - | .46 | .71 | .63 | .45 | .47 | .56 |
| 2. | Picture-word match | .40 | - | .58 | .51 | .50 | .43 | .57 |
| 3. | Spelling | .57 | .52 | - | .77 | .58 | .54 | .60 |
| 4. | Consonant identification | .45 | .73 | .69 | - | .69 | .72 | .59 |
| 5. | Word Recognition | .34 | .66 | .43 | .72 | - | .74 | .62 |
| 6. | Vowel identification | .42 | .49 | .42 | .60 | .73 | - | .50 |
| 7. | Combined Gates-MacGinitie Score | .46 | .63 | .47 | .77 | .83 | .62 | - |

[1]Time 1 intercorrelations are in upper triangle; Time 2 intercorrelations are in lower triangle.

Table 5

Stepwise Multiple Regressions with Time 1 and Time 2 Variables Entered for Predicting Reading Achievment

| Predictor | Multiple $r$ | $r^2$ | s.e. | d.f. | F Value to Enter Equation |
|---|---|---|---|---|---|
| Dependent Variable: Combined Vocabulary + Comprehension Achievement | | | | | |
| Word reading (Time 2) | .834 | .696 | 3.7 | 1, 48 | 109.5 |
| Consonant-sound identification (Time 2) | .869 | .755 | 3.3 | 1, 47 | 11.4 |
| Dependent Variable: Vocabulary Achievement | | | | | |
| Word reading (Time 2) | .808 | .652 | 3.7 | 1,48 | 90.2 |
| Consonant-sound identification (Time 2) | .852 | .725 | 3.3 | 1,47 | 12.6 |
| Picture-word match (Time 1) | .862 | .743 | 3.2 | 1,46 | 2.9 |
| Dependent Variable: Comprehension Achievement | | | | | |
| Word reading (Time 2) | .798 | .637 | 4.6 | 1,48 | 84.4 |
| Consonant-sound identification (Time 2) | .825 | .681 | 4.4 | 1,47 | 6.2 |
| Consonant-sound identification (Time 1) | .834 | .696 | 4.3 | 1,46 | 2.3 |

Table 6

Stepwise Multiple Regressions with Time 2 Variables Entered For Predicting Reading Achievement

| Predictor | Multiple $r$ | $r^2$ | s.e. | d.f. | $F$ Value to Enter Equation |
|---|---|---|---|---|---|
| Dependent Variable: Vocabulary Achievement | | | | | |
| Regular vowel word reading | .793 | .629 | 4.7 | 1,48 | 81.1 |
| Matched consonant-sound identification | .855 | .731 | 4.3 | 1,47 | 18.1 |
| Dependent Variable: Comprehension Achievement | | | | | |
| Regular vowel word reading | .786 | .618 | -1.6 | 1,48 | 77.8 |
| Total consonant-sound identification | .823 | .677 | 5.6 | 1,47 | 8.6 |
| Spelling | .833 | .695 | 3.3 | 1,46 | 2.5 |

Table 7

Stepwise Multiple Regressions with Time 1 Variables Entered

For Predicting Reading Achievement

| Predictor | Multiple $r$ | $r^2$ | s.e. | d.f. | F value to Enter Equation |
|---|---|---|---|---|---|
| Dependent Variable: Vocabulary Achievement | | | | | |
| Not matched consonant-sound identification | .690 | .476 | 2.3 | 1,48 | 43.6 |
| Picture-word match | .742 | .551 | 1.8 | 1,47 | 7.8 |
| Lower case letters | .764 | .584 | 1.5 | 1,46 | 3.7 |
| Regular vowel word reading | .778 | .605 | 1.8 | 1,45 | 2.4 |
| Dependent Variable: Comprehension Achievement | | | | | |
| Regular vowel word reading | .586 | .343 | 2.5 | 1,48 | 25.1 |
| Upper case letters | .649 | .421 | 3.9 | 1,47 | 6.3 |

Table 8

Average Percent Correct for Subtests

as a Function of Reading Achievement

| Subtests | Maximum Possible Score | Bottom 12% (n=6) | | Middle 44% (n=22) | | Upper 44% (n=22) | |
|---|---|---|---|---|---|---|---|
| | | Spr. | Fall | Spr. | Fall | Spr. | Fall |
| Uppercase letters | 10 | 52 | 77 | 99 | 100 | 100 | 100 |
| Lowercase letters | 10 | 53 | 67 | 90 | 94 | 93 | 96 |
| Spelling | 11 | 38 | 53 | 81 | 91 | 93 | 94 |
| Picture-word match | 8 | 40 | 42 | 67 | 78 | 78 | 86 |
| Consonant-sound identification | 32 | 4 | 16 | 58 | 73 | 74 | 90 |
| Short vowel identification | 5 | 3 | 7 | 46 | 55 | 55 | 62 |
| Word reading | 28 | 3 | 3 | 19 | 29 | 39 | 65 |
| Nonshort vowel identification | 15 | 1 | 1 | 8 | 5 | 19 | 33 |

Note: Three groups were formed after ranking children according to their Gates-MacGinitie Averaged Test Score.

## Figure Captions

Figure 1. Testing layout for picture-word subtest.

Figure 2. Scatter plot illustrations.

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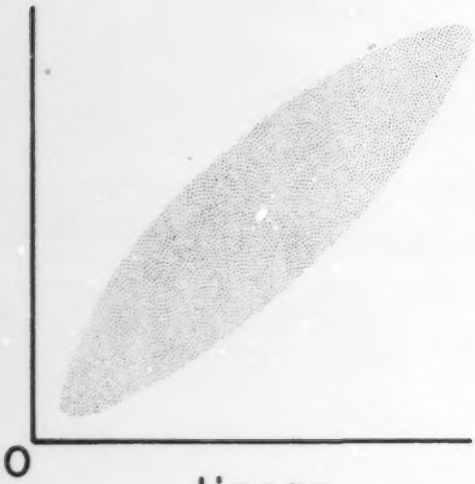


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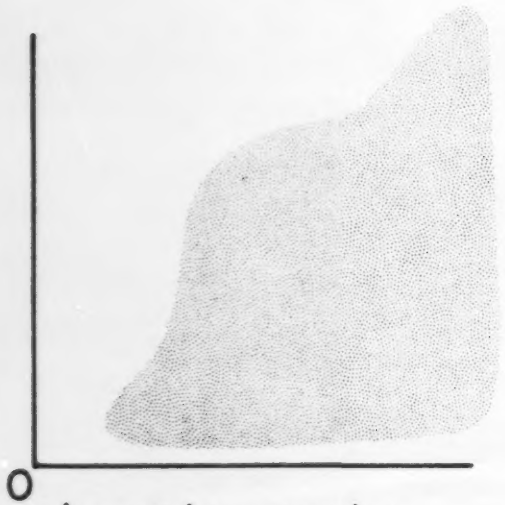


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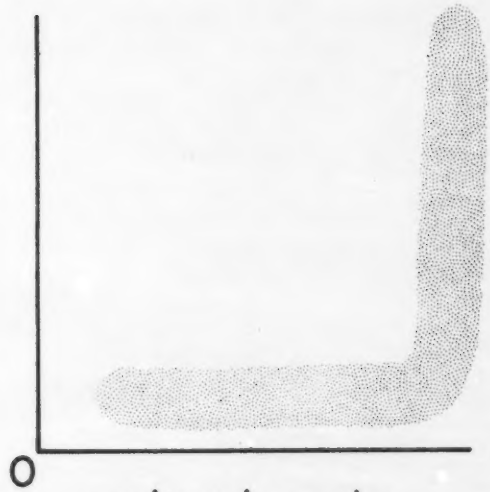


reduced scalar

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